NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

POND

(No.)

CODE 378

DEFINITION

A water impoundment made by constructing an embankment or by excavating a pit or dugout.
In this standard, ponds constructed by the first method are referred to as embankment ponds, and those constructed by the second method are referred to as excavated ponds. Ponds constructed by both the excavation and the embankment methods are classified as embankment ponds if the depth of water impounded against the embankment at the auxiliary spillway elevation is 3 feet or more.

PURPOSE

To provide water for livestock, fish and wildlife, recreation, fire control, and other related uses, and to maintain or improve water quality.

CONDITIONS WHERE PRACTICE APPLIES

This standard establishes the minimum acceptable quality for the design and construction of low-hazard ponds where:

1. Failure of the dam will not result in loss of life; damage to homes, commercial or industrial buildings, main highways, or railroads; or in interruption of the use or service of public utilities.

2. The product of the storage times the effective height of the dam is less than 3,000. Storage is the volume, in acre-feet, in the reservoir below the elevation of the crest of the auxiliary spillway. The effective height of the dam is the difference in elevation, in feet, between the auxiliary spillway crest and the lowest point in the cross-section taken along the center line of the dam. If there is no auxiliary spillway, the top of the dam is the upper limit.

3. The effective height of the dam is 35 feet or less.

GENERAL CRITERIA APPLICABLE TO ALL PONDS

All federal, State and local requirements shall be addressed in the design.

Permits. Under the Tennessee Safe Dams Act, a dam is defined as any structure that is at least 20 feet high from the natural bed of the stream or watercourse at the downstream toe of the dam to the top of the dam or that can impound at least 30 acre-feet of water at the maximum water storage elevation. The maximum water storage elevation is defined as the elevation of the lowest point on the top of the dam, excluding any spillway structures. Provided, however, that any such barrier which is or will be less than (6) feet in height, regardless of storage capacity, or which has or will have a maximum storage capacity not in excess of fifteen (15) acre-feet, regardless of height, shall not be considered a dam.

Certain classes of dams are exempt from regulation under the Safe Dams Act of Tennessee. The main exemption is for "farm ponds." Farm ponds are defined in the regulations as "...any impoundment used only for providing water for agriculture and domestic purposes such as livestock and poultry watering, irrigation of crops, recreation, and conservation, for the owner or occupant of the farm, his family, and invited guests, but does not include any impoundment for which the water, or privileges or products of the water, are available to the general public."

A farm pond may not be exempt from other permitting requirements such as an Aquatic Resource Alteration Permit (ARAP). An ARAP must be obtained when the dam that is being built impounds water on an intermittent or perennial stream or creek.

Permanent vegetation. A protective cover of permanent vegetation shall be established on all exposed areas of embankments, spillways, spoil, and borrow areas as climatic conditions allow, according to the guidelines in conservation practice standard 342, Critical Area Planting.

Site conditions. Site conditions shall be such that runoff from the design storm can be safely passed through (1) a natural or constructed auxiliary spillway; (2) a combination of a principal spillway and an auxiliary spillway; or (3) a principal spillway.

Drainage area. The drainage area above the pond must be protected against erosion to the extent that expected sedimentation will not shorten the planned effective life of the structure. The drainage area shall be large enough so that surface runoff and ground water will provide an adequate supply of water for the intended purpose, unless an alternate water source exists to serve this purpose.

Reservoir area. The topography and geology of the site shall permit storage of water at a depth and volume that will ensure a dependable supply, considering beneficial use, sedimentation, season of use, and evaporation and seepage losses. The soils shall be impervious enough to prevent excessive seepage losses or shall be of a type that sealing is practicable.

CRITERIA APPLICABLE TO WATER FOR LIVESTOCK

Where production livestock have access to the pond, a fence system shall be implemented to protect the shoreline, embankment, and auxiliary spillways, and provide designated watering locations around the pond. Controlled grazing within the fence system is permitted. Consideration shall be given to fencing an area sufficient to form a filter strip around the pond. When livestock watering locations are provided around the pond, they shall be fenced and meet the requirement of NRCS conservation practice standard Heavy Use Area Protection (Code 561). Watering heavy use areas or ramps shall extend to a depth of 3 feet below the anticipated low water elevation at a slope no steeper than four horizontal to one vertical (4:1).

DESIGN CRITERIA FOR EMBANKMENT PONDS

Geological Investigations. Pits, trenches, borings, review of existing data, or other suitable means of investigation shall be conducted to characterize materials within the embankment foundation, auxiliary spillway, and borrow areas. Soil materials shall be classified using the Unified Soil Classification System.

Foundation cutoff. A cutoff of relatively impervious material shall be provided under the dam if necessary to reduce seepage through the foundation. The cutoff shall be located at or upstream from the center line of the dam. It shall extend up the abutments, as required, and be deep enough to extend into a relatively impervious layer or provide for a stable dam when combined with seepage control. The cutoff trench shall have a bottom width adequate to accommodate the equipment used for excavation, backfill, and compaction operations. Side slopes shall not be steeper than one horizontal to one vertical.

Seepage control. Seepage control is to be included, if (1) pervious layers are not intercepted by the cutoff; (2) seepage could create swamping downstream; (3) such control is needed to ensure a stable embankment; or (4) special problems require drainage for a stable dam. Seepage may be controlled by (1) foundation, abutment, or embankment filters and drains; (2) reservoir blanketing; or (3) a combination of these measures.

Embankment. The minimum top width for a dam is shown in Table 1. If the embankment top is to be used as a public road, the minimum width shall be 16 feet for one-way traffic and 26 feet for two-way traffic. Guardrails or other safety measures shall be used where necessary and shall meet the requirements of the responsible road authority. For dams less than 20 feet in height, maintenance considerations or construction equipment limitations may require increased top widths from the minimum shown in Table 1.

Table 1 - Minimum Top Width for Dams

Total Height of Embankment	Top Width
feet	feet
Less than 10	8
10 – 14.9	10
15 – 19.9	11
20 – 24.9	12
25 – 34.9	14
35 or more	15

Side Slopes. The combined upstream and downstream side slopes of the settled embankments shall not be less than five horizontal to one vertical, and neither slope shall be steeper than two horizontal to one vertical. All slopes must be designed to be stable, even if flatter side slopes are required. Downstream or upstream berms can be used to help achieve stable embankment sections.

Slope Protection. If needed to protect the slopes of the dam from erosion, special measures, such as berms, rock riprap, sand-gravel, soil cement, or special vegetation shall be provided (Technical Releases 56, “A Guide for Design and Layout of Vegetative Wave Protection for Earth Dam Embankments,” and 69, “Riprap for Slope Protection Against Wave Action,” contain design guidance).

Freeboard. The minimum elevation of the top of the settled embankment shall be one foot above the water surface in the reservoir with the auxiliary spillway flowing at design depth. The minimum difference in elevation between the crest of the auxiliary spillway and the settled top of the dam shall be 2 feet for all dams having more than a 20-acre drainage area or more than 20 feet in effective height.

Settlement. The design height of the dam shall be increased by the amount needed to ensure that after settlement the height of the dam equals or exceeds the design height. This increase shall not be less than 5 percent of the height of the dam, except where detailed soil testing and laboratory analyses or experience in the area show that a lesser amount is adequate.

Principal spillway. A pipe conduit, with needed appurtenances, shall be placed under or through the dam, except where rock, concrete, or other types of lined spillways are used, or where the rate and duration of flow can be safely handled by a vegetated or earth spillway. Vegetated or earth spillways will not be adequate without a pipe spillway if long duration, continuous, or frequent flows are expected.

For dams with a drainage area of 20 acres or less, the principal spillway crest elevation shall not be less than 0.5 foot below the auxiliary spillway crest elevation.

For dams with a drainage area over 20 acres a principal spillway pipe is required, and the principal spillway crest shall not be less than 1.0 foot below the crest of the auxiliary spillway.

When design discharge of the principal spillway is considered in calculating peak outflow through the auxiliary spillway, the crest elevation of the inlet shall be such that the full flow design discharge will be generated in the conduit before there is discharge through the auxiliary spillway.

Pipe conduits designed for pressure flow must have adequate anti-vortex devices. The inlets and outlets shall be designed to function satisfactorily for the full range of flow and hydraulic head anticipated.

The capacity of the pipe conduit shall be adequate to discharge long-duration, continuous, or frequent flows without flow through the auxiliary spillways. The minimum design storm to use for the principal spillway pipe is listed in Table 2. The diameter of the principal spillway pipe shall not be less than 4 inches. Pipe conduits used solely as a supply pipe through the dam for watering troughs and other appurtenances shall not be less than 1-1/4 inches in diameter.

If the pipe conduit diameter is 10 inches or greater, its design discharge may be considered when calculating the peak outflow rate through the auxiliary spillway.

Pipe conduits shall be ductile iron, welded steel, corrugated steel, corrugated aluminum, reinforced concrete (pre-cast or site-cast), or plastic. Pipe conduits through dams of less than 20 feet total height may also be cast iron or unreinforced concrete. Pipe conduits shall meet the requirements of Tables 3 and 4.

Pipe conduits shall be designed and installed to withstand all external and internal loads without yielding, buckling, or cracking. Rigid pipe shall be designed for a positive, projecting condition. Flexible pipe shall be designed for a maximum deflection of 5 percent. The modulus of elasticity for PVC pipe shall be assumed as one-third of the amount designated by the compound cell classification to account for long-term reduction in modulus of elasticity. Different reductions in modulus may be appropriate for other plastic pipe materials.

The minimum thickness of flexible pipe shall be SDR 26, Schedule 40, Class 100, or 16 gage, as appropriate for the particular pipe material and/or as referenced in Tables 3 and 4. Connections of flexible pipe to rigid pipe or other structures shall be designed to accommodate differential movements and stress concentrations.

All pipe conduits shall be designed and installed to be watertight by means of couplings, gaskets, caulking, waterstops, or welding. Joints shall be designed to remain watertight under all internal and external loading including pipe elongation due to foundation settlement. Bell end High Density Polyethylene pipe is not an acceptable connection unless adequate measures are included to lock pipe conduits together.

Pipe conduits shall have a concrete cradle or bedding, if needed to provide improved support for the pipe to reduce or limit structural loading on pipe to allowable levels.

A hood inlet may be used when the pipe is installed in the dam abutment with any size barrel. The section of pipe on which the hood is installed must be at least 12 feet long and be of steel, aluminum, concrete, PVC, HDPE, or bituminous coated corrugated metal. The hood inlet shall consist of an anti-vortex baffle on top of the pipe and project three-fourths of the diameter of the pipe. The vertical distance between the invert of the pipe and control (level) section of the emergency spillway shall be no less than 1.5 times the diameter of the pipe.

A siphon pipe spillway is a closed conduit system formed in the shape of an inverted "V" positioned so that the invert of the bend (CREST) of the upper passageway is at normal water surface elevation. The initial discharge of the siphon, as the reservoir level rises above normal, is similar to flow over a weir. Siphoning action begins after the air in the siphon pipe has been exhausted, usually at a depth over the crest equal to about 1/3 the pipe diameter. An air vent is provided to break the siphoning action when the reservoir water surface is drawn down to normal pool elevation. Because of the negative pressure that exists within the siphon when flowing full, the pipe joints must be air tight and the pipe must be sufficiently rigid to withstand the collapsing forces. Welded steel or plastic pipe with glued joints should be used. Pipe joints using rubber gasket joints may not be sufficiently airtight to function properly in a siphon system.

The following <u>minimum criteria</u> shall apply to siphon spillway systems, in addition to other applicable criteria listed elsewhere in this standard: The total drop of the siphon will be limited to a maximum of 20 feet. A 2-inch diameter vent pipe will be used on siphon pipes up through 8 inches, and a 4-inch diameter vent pipe will be used for siphons 10 inch through 16 inch diameters. Pipe used for siphons shall be smooth steel or smooth plastic pipe with a minimum wall thickness equivalent to Schedule 40 or SDR 26. The siphon will have an elbow on the downstream end or will be submerged during flow to completely seal the end of the pipe. If an elbow is used, it will have a ¼-inch to 3/8-inch weep hole drilled in the bottom of the elbow to ensure that water does not freeze in the pipe and possibly prevent the siphon from functioning. The pipe will be buried through the dam, and the downstream section of the pipe will be buried or have adequate anchors and restraints to prevent thrust forces and vibrations from breaking it. The vent pipe will be protected by a perforated pipe sleeve to prevent floating debris from clogging the vent. The total area of the perforations in the vent pipe sleeve should equal at least four times the vent pipe area. The inlet to the siphon shall have a perforated section that will exclude trash, turtles, fish, etc. The perforated inlet section must have an open area equivalent to at least two times the cross-sectional area of the siphon pipe.

Cantilever outlet sections, if used, shall be designed to withstand the cantilever load. Pipe supports shall be provided when needed. Other suitable devices such as a Saint Anthony Falls stilling basin or an impact basin may be used to provide a safe outlet.

All steel pipe and couplings shall have protective coatings in areas that have traditionally experienced pipe corrosion, or in embankments with saturated soil resistivity less than 4,000 ohms-cm or soil pH less than 5. Protective coatings shall be asphalt, polymer over galvanizing, aluminized coating, or coal tar enamel as appropriate for the pipe type. Plastic pipe that will be exposed to direct sunlight shall be ultraviolet-resistant and protected with a coating or shielding, or provisions provided for replacement as necessary

Cathodic Protection. Cathodic protection is to be provided for coated welded steel and galvanized corrugated metal pipe where soil and resistivity studies indicate that the pipe needs a protective coating, and where the need and importance of the structure warrant additional protection and longevity. If cathodic protection is not provided in the original design and installation, electrical continuity in the form of joint-bridging straps should be considered on pipes that have protective coatings. Cathodic protection should be added later if monitoring indicates the need.

Seepage Control along Pipe. Seepage control along a pipe conduit spillway shall be provided if any of the following conditions exist:

1. The effective height of dam is greater than 15 feet.

2. The conduit is of smooth pipe larger than 8 inches in diameter.

3. The conduit is of corrugated pipe larger than 12 inches in diameter.

Seepage along pipes extending through the embankment shall be controlled by use of a drainage diaphragm, unless it is determined that anti-seep collars will adequately serve the purpose.

Drainage Diaphragm. The drainage diaphragm shall function both as a filter for adjacent base soils and a drain for seepage that it intercepts. The drainage diaphragm shall consist of sand meeting the requirements of ASTM C-33, for fine aggregate. If unusual soil conditions exist such that this material may not meet the required filter or capacity requirements, a special design analysis shall be made.

The drainage diaphragm shall be a minimum of 2 feet thick and extend vertically upward and horizontally at least three times the outside pipe diameter, and vertically downward at least 18 inches beneath the conduit invert. The drainage diaphragm shall be located immediately downstream of the cutoff trench, but downstream of the center line of the dam if the cutoff is upstream of the center line.

The drainage diaphragm shall be outletted at the embankment downstream toe using a drain backfill envelope continuously along the pipe to where it exits the embankment. Drain fill shall be protected from surface erosion.

Anti-seep Collars. When anti-seep collars are used in lieu of a drainage diaphragm, they shall have a watertight connection to the pipe. Maximum spacing shall be approximately 14 times the minimum projection of the collar measured perpendicular to the pipe, but not more than 25 feet. The minimum spacing shall be 10 feet. Collar material shall be compatible with pipe materials. The anti-seep collar(s) shall increase by at least 15 percent the seepage path along the pipe. Table 5 contains recommended number of anti-seep collars to place along the pipe.

Trash Guard. To prevent clogging of the conduit, an appropriate trash guard shall be installed at the inlet or riser unless the watershed does not contain trash or debris that could clog the conduit.

Other Outlets. A pipe with a suitable valve shall be provided to drain the pool area, if needed for proper pond management or if required by State law. The principal spillway conduit may be used as a pond drain if it is located where it can perform this function.

Auxiliary spillways. Auxiliary spillways convey large flood flows safely past earth embankments and have historically been referred to as "Emergency Spillways." An auxiliary spillway must be provided for each dam, unless the principal spillway is large enough to pass the peak discharge from the routed design hydrograph and the trash that comes to it without overtopping the dam. The following are minimum criteria for acceptable use of a closed conduit principal spillway without an auxiliary spillway: A conduit with a cross-sectional area of 3 ft.^{2} or more, an inlet that will not clog, and an elbow designed to facilitate the passage of trash.

The minimum capacity of a natural or constructed auxiliary spillway shall be that required to pass the peak flow expected from a design storm of the frequency and duration shown in Table 2, less any reduction creditable to conduit discharge and detention storage.

The auxiliary spillway shall safely pass the peak flow, or the storm runoff shall be routed through the reservoir. The routing shall start either with the water surface at the elevation of the crest of the principal spillway or at the water surface after ten days' drawdown, whichever is higher. The ten-day drawdown shall be computed from the crest of the auxiliary spillway or from the elevation that would be attained if the entire design storm were impounded, whichever is lower. Auxiliary spillways shall provide for passing the design flow at a safe velocity to a point downstream where the dam will not be endangered.

Constructed auxiliary spillways are open channels that usually consist of an inlet channel, a control (level) section, and an exit channel. They shall be trapezoidal and shall be located in undisturbed or compacted earth or in-situ rock. The side slopes shall be stable for the material in which the spillway is to be constructed. For all embankment dams, the auxiliary spillway shall have a bottom width of not less than ten (10) feet.

Upstream from the control section, the inlet channel shall be level for the distance needed to protect and maintain the crest elevation of the spillway and provide adequate drainage back into the pond. The inlet channel may be curved to fit existing topography. The control section shall be constructed a minimum length of 25 feet at the design crest elevation. The grade of the exit channel of a constructed auxiliary spillway shall fall within the range established by discharge requirements and permissible velocities.

Structural auxiliary spillways. If chutes or drops are used for principal or auxiliary spillways, they shall be designed according to the principles set forth in Part 650, Engineering Field Handbook, and the National Engineering Handbook, Section 5, Hydraulics; Section 11, Drop Spillways; and Section 14, Chute Spillways. The minimum capacity of a structural spillway shall be that required to pass the peak flow expected from a design storm of the frequency and duration shown in Table 2, less any reduction creditable to conduit discharge and detention storage.

CRITERIA FOR EXCAVATED PONDS

Runoff. Provisions shall be made for a pipe and auxiliary spillway, if needed, that will meet the capacity requirements of Table 2. Runoff flow patterns shall be considered when locating the excavated pond and placing the spoil.

Side slopes. Side slopes of excavated ponds shall be stable and shall not be steeper than one horizontal to one vertical.

Inlet protection. If surface water enters the pond in a natural or excavated channel, the side slope of the pond shall be protected against erosion.

Excavated material. The material excavated from the pond shall be placed so that its weight will not endanger the stability of the pond side slopes and it will not be washed back into the pond by rainfall. It shall be disposed of in one of the following ways:

1. Uniformly spread to a height that does not exceed 3 feet, with the top graded to a continuous slope away from the pond.

2. Uniformly placed or shaped reasonably well, with side slopes assuming a natural angle of repose. The excavated material will be placed at a distance equal to the depth of the pond, but not less than 12 feet from the edge of the pond.

3. Shaped to a designed form that blends visually with the landscape.

4. Used for low embankment construction and leveling of surrounding landscape.

5. Hauled away.

Additional Criteria for Livestock Water

When the purpose of the pond is to provide water to livestock, the pond, embankment, and spillways shall be excluded from use by livestock and a water facility provided in accordance with NRCS conservation practice standard, Watering Facility (Code 614).

The required storage shall be calculated using 1.5 times the sum of the following:

1. The specified minimum gallons per animal per day as stated in NRCS conservation practice standard Watering Facility, Code 614, for the estimated number of days to be used.

2. The net evaporation loss for the design days of storage.

3. Seepage loss based on the best available data.

Additional Criteria for Fish and Wildlife

The reservoir shall be designed where at least 85 percent of the water depth is in excess of three (3) feet.

Additional Criteria for Recreation

The volume of water should be sufficient to exceed evaporation and seepage losses and maintain a desirable water level. The water must be free of pollution, especially where it is to be used for swimming.

Additional Criteria for Fire Protection

Fire protection shall be incorporated into the structure design with an underground piping system that connects the reservoir to a dry hydrant. Minimum water storage, location of intake pipe, etc., shall meet the requirements of Tennessee NRCS conservation practice standard Dry Hydrant, Code 432. The pump shall be of sufficient capacity and hoses shall be of sufficient length to reach the structures to be protected.

Additional Criteria for Crop and Orchard Irrigation

The capacity of the pond shall be adequate to meet the irrigation requirement of the planned crop(s). The required capacity shall be based on the irrigation requirements of the crops to be irrigated, the effective rainfall expected during the growing season, the application efficiency of the irrigation method used, the losses due to evaporation and seepage, and the expected inflow into the pond.

Additional storage shall be provided for the estimated volume of sediment that will be deposited during the life of the structure.

Suitable means should be provided to convey water from the pond to the spray equipment. To prevent contamination of the water supply from the spray equipment into which chemicals are injected, the design must incorporate backflow prevention devices.

Chemigation shall be applied in conformance with NRCS Tennessee conservation practice standards Nutrient Management, Code 590, and Pest Management, Code 595.

Additional Criteria for Maintaining and Improving Water Quality

Water quality problems include sediment, fertilizers, pesticides, litter, oils, and solvents. A reduction of peak flows to a receiving stream or water body will slow water flow and thereby carry less suspended solids. Ponds designed for water quality improvement of downstream water bodies shall be designed so that the first flush of a storm event will be retained within the pond and later storm water flow will be the first flows released through the principal spillway. In addition, the pond will be designed with a permanent pool deep enough to hold water all year and with shallow areas (littoral zones) with dense vegetation. These practices will increase sedimentation of suspended solids, reduce resuspension of sediments by wave action, remove floating debris from storm water, and aid in mosquito control.

Table 2 - Minimum Spillway Capacity

			Minimum Design Storm Frequency 2/		
Drainage Area	Effective Height of Dam 1/	Storage	Principal Spillway	Auxiliary Spillway	Minimum Duration
Acre	Ft.	Ac.-Ft.	Yr.	Yr.	Hr.
< 20	< 20	< 50	1	10	24
< 20	> 20	< 50	2	25	24
> 20 to < 100	< 20	< 50	2	25	24
> 20 to < 100	> 20	< 50	2	50	24
> 100 to < 250	< 20	< 50	5	25	24
> 100 to < 250	> 20	< 50	5	50	24
> 250	< 20	< 50	10	25	24
All Others			10	50	24

1/ As defined under "Conditions."
2/ Select rain distribution based on climatological region.

Table 3 - Minimum Acceptable Plastic Pipe for use in Earth Dams 1/

Type of Plastic Pipe	Nominal Pipe Size (Inches)	Maximum Depth of Fill Over Pipe (Feet)
Smooth Wall PVC Pipe 2/		
ASTM D2241 SDR 32.5	4, 6, 8, 10, 12	8
ASTM D2241 SDR 26	4, 6, 8, 10, 12	13
ASTM D2241 SDR 21	4, 6, 8, 10, 12	17
ASTM D2241 SDR 17	4, 6, 8, 10, 12	24
ASTM D1785 Schedule 40	10, 12	8
ASTM D1785 Schedule 40	6, 8	13
ASTM D1785 Schedule 40	4	20
ASTM D1785 Schedule 80	10, 12	20
ASTM D1785 Schedule 80	4, 6, 8	25
AWWA C900 Class 100	4, 6, 8, 10, 12	13
AWWA C900 Class 150	4, 6, 8, 10, 12	18
AWWA C900 Class 200	4, 6, 8, 10, 12	25
Corrugated Smooth-Lined Polyethylene and PVC 3/		
HDPE, PVC	4 - 18	15
HDPE, PVC	24 - 36	10

1/ Plastic pipe manufactured to conform to ASTM Specifications other than those listed may be used with the maximum fill limits shown provided the pipe meet or exceed the requirements of the listed pipes for materials, wall thickness, and joint water tightness. Pipe having a wall thickness different from the listed pipes may be used provided the calculated long-term deflection for the designed fill height and installation conditions does not exceed 5 percent.
2/ Polyvinyl chloride pipe, PVC 1120 or PVC 1220, conforming to ATSM-D1785 or ATSM-D2241. Class 12454-A, 12454-B, or 12454-C polyvinyl chloride pipe (ASTM D1784).
3/ Polyethylene, Type III, Class C, Category 4 or 5 conforming to ASTM D1248 and D3350 and AASHTO M252 or M294, Type S; PVC, ASTM F949.

Table 4 - Minimum Gage for Corrugated Metal Pipe

(2-2/3-in x ½-in corrugations)[1/]

Fill Height Over Pipe *Feet*	Steel CMP *Diameter in Inches*					Aluminum CMP [2/] *Diameter in Inches*			
	< 24	**30**	**36**	**42**	**48**	**< 21**	**24**	**30**	**36**
1 to < 15	16	16	14	12	10	16	16	14	14
15 to < 20	16	16	14	12	10	16	16	12	12
20 to < 25	16	14	12	10	10	16	12	10	----[3/]

(3 inch x 1 inch corrugations)[4/]

Fill Height Over Pipe *Feet*	Steel CMP *Diameter in Inches*					
	36	**42**	**48**	**54**	**60**	**72**
1 to < 15	16	16	16	16	16	16
15 to < 20	16	16	16	16	14	14
20 to < 25	16	16	14	12	10	8

1/ Pipe with 6-, 8-, and 10-inch diameters have 1-1/2 in. x ¼-in. corrugations.
2/ Riveted or helical fabrication.
3/ Not permitted.
4/ n = 0.027.

Table 5 - Recommended Number of Anti-Seep Collars

Fill Height [1/]	Collar Projection 1.5 ft. [2/]	2.0 ft. [2/]	2.0 ft. [3/]
0 - 13.9	1	1	1
14 - 16.9	2	1	2
17 - 21.9	3	2	3
22 - 26.9	4	3	4
27 - 31.9	5	4	5
32 - 35	6	4	5

1/ Fill height is the fill over the invert of the pipe at centerline of dam. (This height should not be used for hooded inlet and similar types of installations.)
2/ Collars computed on side slopes of 2 1/2:1 + top width x 0.75 for saturated zone.
3/ Computed on 3:1 slopes + top width x 0.75 for saturated zone.

CONSIDERATIONS

Visual resource design. The visual design of ponds should be carefully considered in areas of high public visibility and those associated with recreation. The underlying criterion for all visual design is appropriateness. The shape and form of ponds, excavated material, and plantings are to relate visually to their surroundings and to their function.

The embankment may be shaped to blend with the natural topography. The edge of the pond may be shaped so that it is generally curvilinear rather than rectangular. Excavated material can be shaped so that the final form is smooth, flowing, and fitting to the adjacent landscape rather than angular geometric mounds. If feasible, islands may be added for visual interest and to attract wildlife.

Cultural Resources. Consider existence of cultural resources in the project area and any project impacts on such resources. Consider conservation and stabilization of archaeological, historic, structural, and traditional cultural properties, when appropriate.

Fish and Wildlife. Project location and construction should minimize the impacts to existing fish and wildlife habitat.

When feasible, structures should be retained in the pool area such as trees in the upper reaches of the pond and stumps in the pool area. Upper reaches of the pond can be shaped to provide shallow areas and wetland habitat. Irregular pond bottoms improve fish habitat. Vertically placed artificial structures can also be placed in the pool area before pond begins to fill up.

Consider independent drain pipe to allow drawdown for weed control or shoreline maintenance.

Consider mid-depth inlet of principal spillway pipe to buffer downstream water temperature.

Vegetation. Stockpiling topsoil for placement on disturbed areas can facilitate revegetation.

Consider placement and selection of vegetation to improve fish and wildlife habitat and species diversity.

Vegetate pool area with quick-growing, temporary vegetation.

Ponds will affect the water budget, especially effects on volumes and rates of runoff, infiltration, evaporation, transpiration, deep percolation, and ground water recharge. Generally, the peak discharge will be reduced and in many instances reduced to zero during dry periods that could affect other water uses or users. There may be an increase in recharge to the ground water, since most ponds seep and the base flow may extend for a longer period of time. Effects on the volume of downstream flow may prohibit undesirable environmental, social, or economic effects.

Ponds have the potential for multiple uses. Storage requirements for each purpose should be considered to ensure an adequate water supply for all intended uses. Ponds used for multiple uses should be compatible.

Properly designed ponds will trap nutrients, sediments, and pesticides. Therefore, chemical concentrations will normally be higher in the pond area and lower in the downstream channel section.

Short-term and construction-related effects of this practice may affect the quality of downstream water courses.

Surface water temperature of the pond will increase and may affect the temperatures of downstream water and cause undesired effects on aquatic and wildlife communities.

Ponds constructed in upland areas may have a positive effect on wildlife habitats.

Ponds constructed in wetland areas must be evaluated to ensure the net wetland benefits are maintained or increased.

Where water must be conveyed for use elsewhere, such as for irrigation or fire protection, ponds should be located as close to the point of use as feasible.

Ponds used for public recreation should have minimum facilities such as access roads, parking areas, boat ramps or docks, and drinking and sanitary facilities. Where areas are used for swimming, safety signs should be installed indicating the depth of water and flatter side slopes should be installed for safety. Water should be tested for quality on a regular basis.

During the construction of ponds, there is the potential for earth moving to uncover or redistribute toxic materials.

- Due consideration should be given to economics, safety, and health factors.
- Effects of water levels on soil nutrient processes such as plant nitrogen use or denitrification.
- Effects of soil water level control on the salinity of soils, soil water, or downstream water.
- Potential for earth moving to uncover or redistribute toxic materials such as saline soils.

PLANS AND SPECIFICATIONS

Plans and specifications for installing ponds shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose.

OPERATION AND MAINTENANCE

An operation and maintenance plan shall be developed and reviewed with the landowner or individual responsible for operation and maintenance.

REFERENCES

Tennessee Department of Environment and Conservation, Div. of Water Supply. Chapter 1200-5-7. “Rules and Regulations Applied to the Safe Dams Act of 1973.” http://www.state.tn.us/sos/rules/1200/1200-05/1200-05-07.pdf

U.S. Department of Agriculture, Natural Resources Conservation Service. 09/97. “Ponds - Planning, Design, Construction.” Agriculture Handbook AH-590. 09/97.

U.S. Department of the Interior, Tennessee Wildlife Resources Agency. 2000. “Managing Small Fishing Ponds and Lakes in Tennessee.” 8th Rev.